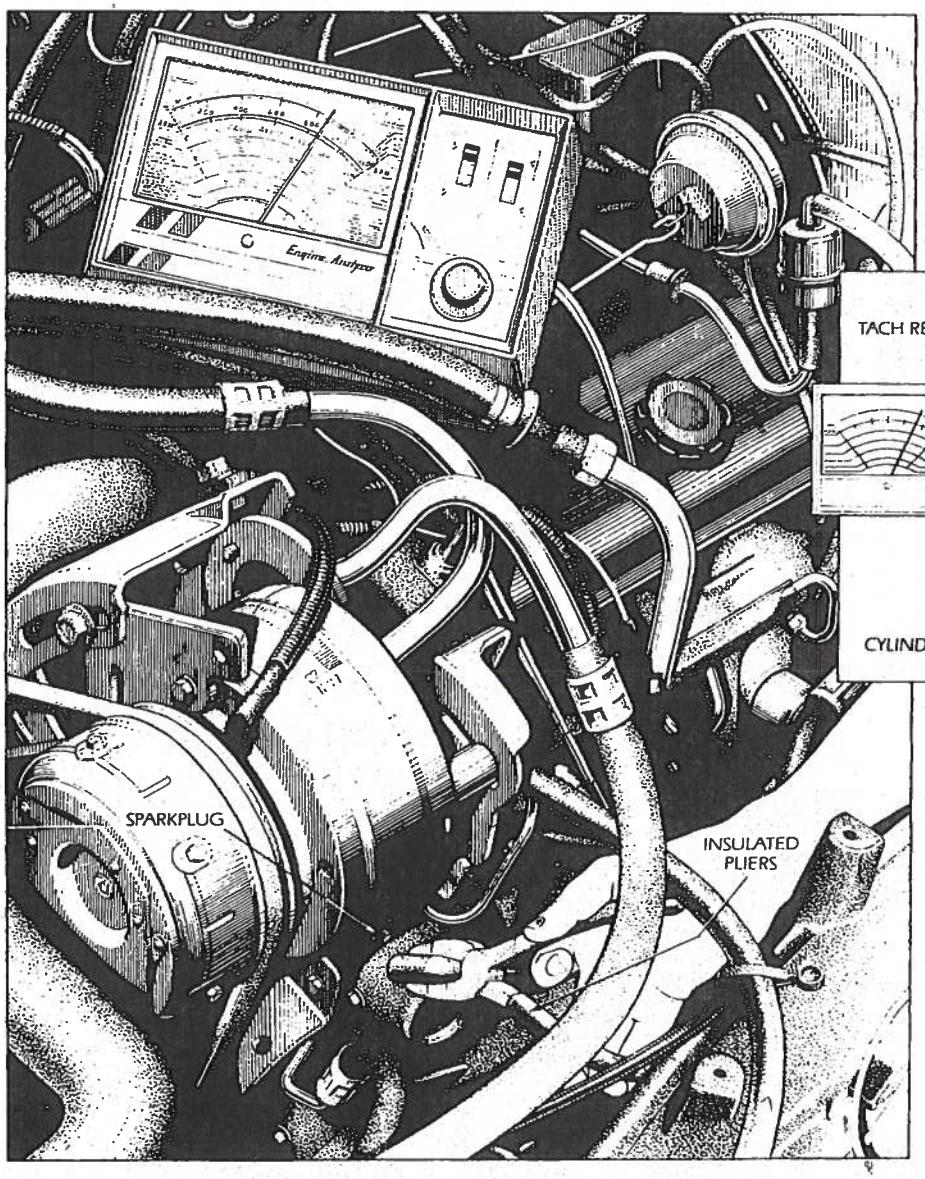
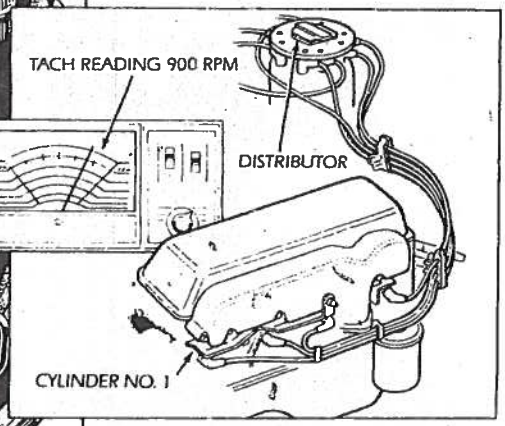
SMOOTH THAT ROUGH IDLE

BY PAUL STENQUIST

There are a lot of little car problems or malfunctions that you can learn to live with. There are others, however, that make driving unpleasant and sometimes lead to more expensive failures if ignored. One of these is a rough idle. In its most benign form, a rough idle may be nothing more than a slight vibration and spitting from the exhaust. More severe cases may shake the vehicle so hard that other parts threaten to rattle off. Eventually the hydrocarbon-laden exhaust will ruin the catalytic converter and O_2 sensor.

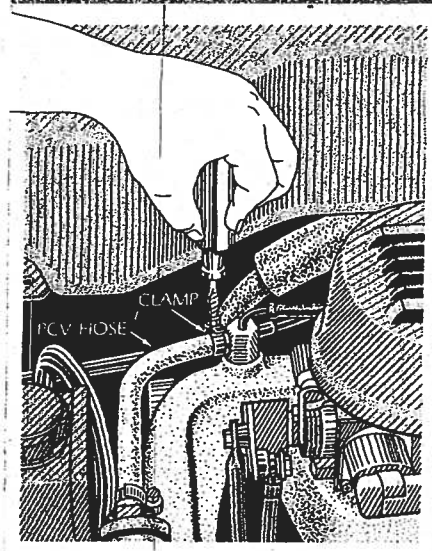




Cylinder balance test can pinpoint a problem cylinder. Remove and ground plug wires sequentially to see which cylinder isn't firing. But be careful and use insulated pliers to avoid a very high-voltage surprise. Rpm won't drop when you've found the bad one.

What's going on?

When an engine idles roughly it's because one or more cylinders are running out of sequence, inefficiently or are completely dead. If the misfire clears up above idle, you can usually rule out internal engine problems right away. An engine may seem to run okay at



1 Secure larger hoses with screw clamps to cure misfire from vacuum leaks. Tighten until rubber extrudes through clamp.

high rpm even with a misfire because the increased speed masks the roughness. Before attempting any diagnosis, make sure timing and idle speed are adjusted to spec. Then check to see that the choke (if any) closes when the engine is cold and opens when the engine is warm.

Engine control system

Most cars produced since 1981 have a computerized engine control system. The computer will record trouble codes when engine operating faults occur. Some manufacturers, including Ford and Chrysler, suggest that the computer system troublesnooting routines should be performed after conventional diagnosis. GM instructs its mechanics to check for computer-system trouble codes and carry out the indicated diagnostic operations prior to conventional troubleshooting. You'll find detailed instructions for diagnosing GM, Ford and Chrysler computer systems in past issues of POPULAR MECHANICS, or your factory service manual.

The most important thing to remember in respect to computerized engines is that conventional troubleshooting and computer-system diagnosis are interrelated. In other words, a fault such as a vacuum leak can be uncovered through normal diagnostic routines yet it might set a trouble code in the computer's memory.

Vacuum leaks

Sometimes a rough idle can be cured with a visual inspection. This is particularly true if the engine has just been worked on, as it's easy to leave a hose disconnected or mix up the engine's firing order.

To check vacuum hose connections, find the vacuum hose diagram for your car, probably in the engine compartment somewhere, frequently on the Vehicle Emission Control Information Label. Make sure all hoses are connected as indicated on the diagram. Make sure they fit tightly on their respective pipes. If not, replace them or, if they're larger hoses like those used for power brakes and are in good condition, secure them with screw-type hose clamps (Fig. 1). Visually check every hose for kinks or splitting.

Once you're sure all the vacuum hoses are in good shape and properly connected, have the engine running at idle and squeeze each hose closed near the point where it connects to its vacuum source (Fig. 2).

If the idle smooths out when you squeeze off the hose, either the hose itself is leaking or the component it's connected to is defective.

When you're certain that the vacuum hoses and the components they're attached to are not causing the rough idle, check the intake manifold gaskets by spraying nonflammable solvent on them while the engine is running. If the idle smooths out, the manifold gaskets are leaking and you'll have to remove the manifold to replace them. While the intake manifold is off, check it for cracks or warpage.

Check the bolts that hold the carb or throttle body onto the intake manifold (Fig. 3). These bolts frequently come loose and can cause a rough or erratic idle. Check the carb base or throttle-body gasket by spraying nonflammable solvent on it like you did for the intake manifold.

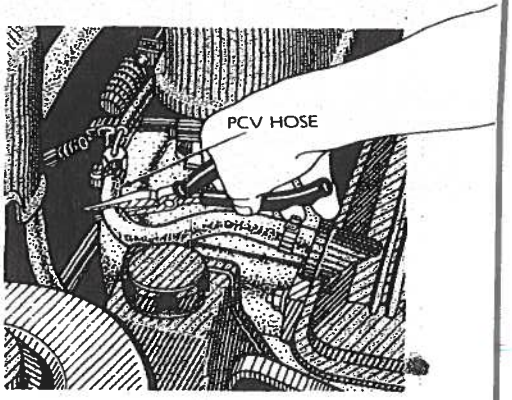
Most cars produced since 1975 have exhaust gas recirculation valves (EGR). If the valve sticks open at idle or if an improper hose connection causes vacuum to be applied to it at idle, it will make the engine run rough. To check, warm the engine fully, disconnect the vacuum hose to the valve, and plug the hose. If this clears up the idle, the hose is improperly connected or there is a fault in the valve's vacuum control system.

If disconnecting and plugging the EGR vacuum supply doesn't clear up the idle, remove the EGR valve and cut out a piece of cardboard to the same shape as the base of the valve. Cut holes for the bolts but not for the valve's ports. Grease both sides of the cardboard and reattach the valve to the engine with the cardboard under it, blocking the exhaust and intake passages. With the valve's vacuum hose disconnected and plugged, start the engine. If the idle is now smooth, the valve is defective and must be replaced. If the idle is still rough, the valve is not at fault. Unbolt the EGR valve, remove the cardboard and reinstall the valve with a new gasket.

Ignition wire routing and condition

A check of ignition wire routing is next. Determine the firing order for your engine and make sure all the plug wires are connected properly.

The firing order for most engines is stamped on the intake manifold, or you should check the shop manual. On late-model GM engines, it's marked on the plug wire retaining ring.



2 Squeezing off vacuum lines with pliers can isolate a suspect component. Use smooth-jawed pliers or cover with rag.

On GM and Chrysler V8s, cylinder No. 1 is farthest forward on the left bank of the engine. Left bank means the left side as you would see it from the driver's position. The other cylinders on the left bank are 3, 5 and 7. On the right bank are 2, 4, 6 and 8.

On Ford V8 engines, cylinders 1, 2, 3 and 4 are on the right bank; 5, 6, 7 and 8 are on the left bank. The same two numbering systems apply to the various makers' V6 engines. Inline 6- and 4-cylinder engines are simply numbered front to rear.

To check firing order, simply take the first number in the order, usually 1, and trace that wire back from the corresponding sparkplug to the distributor cap. Then, moving around the distributor cap in the direction of distributor rotation, check to see that each wire is connected to the proper sparkplug. If you don't know the direction of distributor rotation, remove the cap and bump the engine with the starter to see which way the distributor shaft rotates.

For example, if you were checking plug wire connections on a Chevy V8,

you'd find that the firing order is 1,8,4,3,6,5,7,2. The rotation is clockwise, and No. 1 cylinder is front, left bank. So you'd trace the wire from the front, left bank cylinder back to the distributor cap. Then you'd locate the next wire on the cap in a clockwise direction and make sure it was attached to the sparkplug for the No. 8 cylinder, the last one on the right bank.

As you check, examine each wire for cracks, hardness or splits. Make sure that the wires are securely connected and that the terminals are free of corrosion. Sometimes you can detect bad wires by watching the engine idle at night, as you'll see blue sparks where the current arcs to ground. If you're not sure about the condition of the wires and if they're several years old, replace them. For high-voltage ignition, like GM HEI or Ford EEC IV, use the same 8-mm silicone-jacketed wires that the car was originally equipped with.

While silicone-jacketed wires are much more expensive than conventional types, they also offer much better insulation and will last much longer. The silicone-jacket wires are available in 7-mm size for conventional ignition systems. On cars with computer systems or radios, make sure you get carbon-core, TVRS-type wire.

Cylinder balance test

If the visual or computer system tests don't uncover the cause of the rough idle, a cylinder balance test can determine which cylinders are misfiring. You'll need a tachometer and a pair of pliers with insulated handles. Remove the air cleaner and plug the vacuum line or lines that are joined to it. Connect the tachometer and unplug the idle speed control motor, if there is one (most computerized systems have this).

Then, while watching the tach, pull the plug wire off the No. 1 cylinder's sparkplug and hold the wire terminal next to the cylinder head so it can arc to ground. Note how much the engine speed drops when you remove the wire (see lead illustration). Continue in the same way, checking each cylinder for rpm drop.

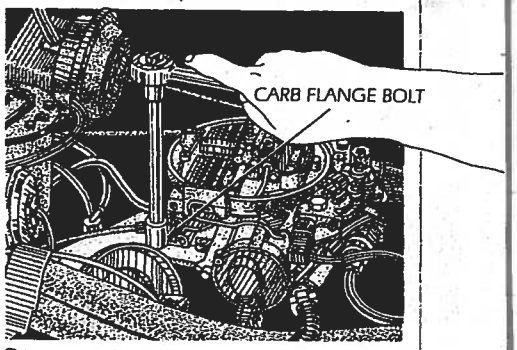
If the engine speed doesn't drop on one or more of the tested cylinders, or if it drops much less than it did on the others, the cylinder is probably not running or it's running very poorly (see chart, Fig. 5).

If you don't see the spark arc to ground when the wire of a dead cylinder is removed, attach the wire terminal firmly to the end of a screwdriver and hold it by the insulated handle with the shaft close to a clean metal ground while an assistant starts the engine.

For cars with high-energy ignition, use a spark tester instead of the screwdriver to prevent shock. Spark testers are available from GM dealers (ask for the ST 125 tester) or from most auto parts stores.

The wire attaches to one end of the tester and the other end has a clamp that you attach to ground before starting the engine. In either case, you should see spark when the engine is running. If you don't, the wire or the distributor cap is defective.

Replacing both the cap and wires is an almost certain cure if you're not getting spark at one or two wire ends, but you can check individual wires with an ohmmeter if you wish. Connect the meter leads to each end of the wire. Resistance should be less than 30,000 ohms for most applications (Fig. 6). If you're not sure about the condition of a wire, compare its resistance reading to a known good wire. Examine the cap for cracks or corrosion. Replace it if you're not certain of its condition.



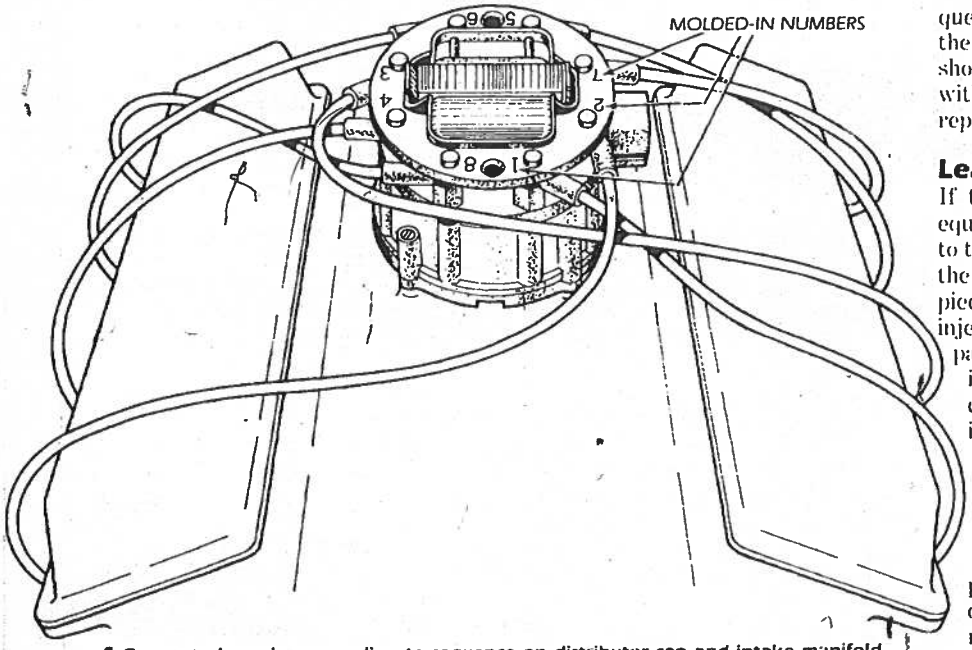
3 Loose carb or throttle-body base bolts can be a source of vacuum leaks. Chase leaks with nonflammable spray solvent.

If you do see spark but the cylinder failed the balance test, either the plug is bad, there's an intake manifold vacuum leak that you missed, an internal engine problem is affecting that cylinder, or the cylinder is not getting fuel.

Remove the plug for the cylinder in question. If it really wasn't running and the cylinder was getting fuel, the plug should be black and wet. Replace it with a good plug, start the engine and repeat the balance test.

Lean misfire

If the plug is okay and your car is equipped with port fuel injection, listen to the injector for the weak cylinder as the engine idles. Use a stethoscope or a piece of hose. You should hear the injector open and close rapidly. Compare its sound to that of the other injectors. If it doesn't open and close, turn off the engine, unplug the injector and connect a test light to the harness connector. Crank the engine; the light should flash on and off. If it does, the injector is bad. If it doesn't, there's a problem in the wiring or in the engine computer system. Repair as necessary or repeat the computer system diagnostics. If the light does flash, the injector is probably just dirty. In



4 Connect plug wires according to sequence on distributor cap and intake manifold.

many cases if one injector is dirty, the others are as well. This may be evidenced by numerous cylinders showing marginal rpm drops on the power balance test.

Sometimes dirty injectors can be cleaned by adding a can of injector cleaner to the fuel tank. One such product, which seems to be more powerful than most others, is available through Chevron filling stations. At about $8 a can, it is also considerably more expensive than other injector cleaners.

Some manufacturers of port-injected vehicles recommend the Chevron product and supply it through their parts department. Remember, however, that there is always some danger in using any high-powered solvent in that it could cause deterioration of fuel-system parts on some vehicles. All owners of injected cars, both throttle body and port, should use fuel that includes a detergent.

On carbureted or throttle-body injected cars, it's not likely that one cylinder could be totally fuel-starved unless there's an internal engine problem. However, the engine can idle roughly due to intermittent lean misfire on all or some cylinders. On V6 or V8 engines with dual-plane intake manifolds, you may sometimes find the misfire and poor power balance readings on one bank only. This means that the idle circuit on the side of the carburetor that feeds that bank or the injector on that side of the throttle body is clogged, or misadjusted.

Checking the valve train

If a valve for a particular cylinder doesn't open or close, the cylinder won't run. To check valve-train parts, remove the valve cover on the side of the engine with the dead cylinder. Check the two pushrods, rocker arms and valve springs for that cylinder. Look for bent pushrods, broken rockers, broken valve springs, misadjusted rockers or—on engines with ball-and-socket rockers like the Chevy V8—a rocker stud may have pulled out of the head. A stuck valve is fairly common on engines that have been in storage for a considerable amount of time.

If you find a broken spring, you can pressurize the cylinder with a spark-plug hole air-hose adapter and an air compressor. This will prevent the valve from falling into the engine when the spring is removed.

Then use one of the widely available "on engine" valve-spring compressors to remove the spring and replace it with a new one. You may need to hold the engine in position with a wrench on the front pulley when you pressurize the cylinder.

A stuck valve can usually be freed up by squirting penetrating oil on the guide and then pushing on the valve. Sometimes a few taps with a plastic or brass mallet, square on the end of the valve stem, may be necessary to loosen the stuck valve.

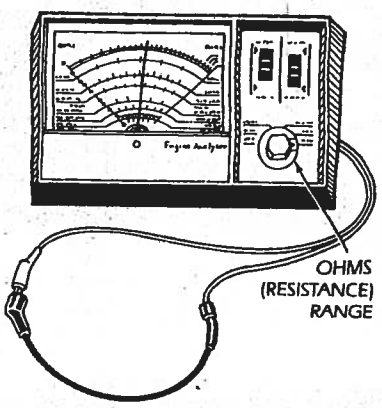
Bent pushrods are easy to replace on most engines. If the pushrod is damaged, check the rocker arm carefully for galling or burrs, and shine a flashlight down into the camshaft valley to make sure the lifter is secure and hasn't hopped out of its bore.

If you don't see any signs of valve-train damage, rotate the engine with a wrench on the front pulley and watch both valves for the offending cylinder to make sure they open and close. If one or both don't open, either the camshaft has been worn flat, the rocker arm adjustment is backed off, or—with ball-and-socket rockers like those on a Chevy V8—the stud may have pulled out. If the stud has pulled part way out, remove it by removing the rocker arm and stacking washers on the stud until you have just enough room to screw on the nut. Then run the nut down, raising the stud. If you get to the end of the stud's threads before it's out of the head, add more washers. Install a new stud using an anaerobic stud and bearing retainer compound.

Put a nut on the end of the stud and tap it in carefully. Don't start the engine for at least 24 hours.

CYLINDER	ENGINE RPM PLUG WIRE ON	ENGINE RPM PLUG WIRE OFF	CONCLUSION
1	900	825	OK
2	900	835	OK
3	900	900	NOT RUNNING
4	900	840	OK
5	900	890	VERY WEAK
6	900	830	OK
7	900	820	OK
8	900	835	OK

5 *Cylinders should show similar rpm drop when wires are off.*



6 *Check the resistance of the sparkplug wires with an ohmmeter. Resistance should be no more than 30 Kohms.*

If the camshaft is flat, you're in for a major repair job. Consult your shop manual for instructions on removing and replacing the cam. You can be sure that you'll have to remove the radiator and grill. And remember, all those metal filings from the old cam are in the engine. You might end up spinning a bearing or wiping out the new cam. A complete engine rebuild is best. If you don't want to go that far, at least pull the oil pan and clean it. Then flush the engine's valley with solvent before installing the new cam. While you've got the pan off, you ought to have a look at the bearings and oil pump.

Other internal problems

If the valve train checks out okay, the cause of the misfire is probably a compression leak, either a bad head gasket, a burned valve or extremely bad rings. Check compression with a compression gauge and compare it to other cylinders. If down more than 30 percent, it could cause a rough idle.

Pressurize the cylinder with a spark-plug hole air-hose adapter and a compressor. Then listen for the air leak. If the culprit is an exhaust valve, you'll hear it in the exhaust pipe. If it's an intake valve, you'll hear air rushing out the throttle. If it's the rings or a broken piston, you should hear air through the oil filler hole. You'll hear at least some sound of air rushing in all these places; you have to compare them to see which is the real source. A bad head gasket will usually produce air bubbles in the cooling system. Remove the thermostat housing to check for them.

For specific information on giving your car a valve job, see *Saturday Mechanic* in the March '87 issue of POPULAR MECHANICS (page 145). **PM**